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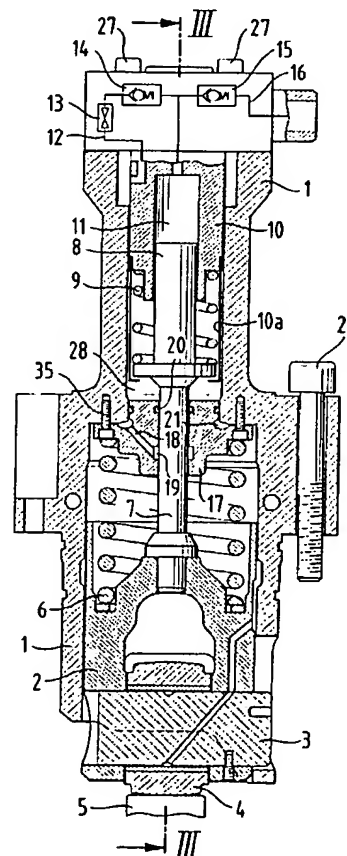
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(54) Integrated pump and tappet unit in a fuel feeding system

(57) An integrated pump and tappet unit for a fuel feeding system of an internal combustion engine, especially a large diesel engine. The unit comprises a body part (1) enclosing a tappet member (2), whose axial movement is governed by movement of a cam shaft, and a piston member (8) operationally connected to the tappet member and which is arranged to pump fuel under high pressure from the fuel chamber (11) in the body part (1) either directly or through a pressure accumulator means into one or more cylinders of the engine. The body part (1) is a single member housing both the tappet member (2) and the fuel chamber (11). The tappet member (2) and the piston member (8) are connected to each other by means of a tappet arm (7), which is sealed to a flange member (17) fixed to the body part (1), so that fuel from the fuel chamber (11) is prevented from coming into contact with the tappet member (2).

Fig. 1



## Description

[0001] This invention relates to fuel pumps for internal combustion engines of the type comprising an integrated pump and tappet unit. In particular, though not exclusively, the invention relates to fuel pumps for large diesel engines for use as main propulsion or auxiliary engines for ships or for power plants for production of heat and/or electricity.

[0002] In order to ensure injection of fuel at the correct point of the working cycle of the cylinder accurate timing is required, and this is normally achieved by means of a tappet member whose movement is determined by a rotating cam shaft. In so-called "common pressure" or "common rail" systems such phasing is not necessary, but even so tappets are often used. Conventionally, the pump and tappet are arranged as entirely separate units, which has the advantage that fuel (for example heavy oil as utilized in modern engines) cannot enter the tappet unit, and is therefore prevented from mixing with and degrading the lubrication oil therein. However, the use of separate units increases manufacturing costs and bulk.

[0003] In alternative pump units the pump and tappet are connected to each other, which makes the construction simpler and decreases manufacturing costs. In this arrangement, however, there is a risk that the tappet lubrication will become contaminated with fuel from the pump, thus adversely affecting the quality and circulation of lubricant. This may result in the pump and the tappet becoming stuck, and at its worst this can have damaging knock-on effects, for example damage to crank shaft bearings.

[0004] The invention seeks to overcome these disadvantages and to provide an improved pump and tappet unit which can achieve the advantages of integration whilst avoiding the problems associated with existing integral arrangements.

[0005] The invention provides integrated pump and tappet units as defined in claim 1 and its subsidiary claims. In accordance with the invention the body part is constructed as an integral piece and the tappet member and the piston member are connected to each other by means of a tappet arm which is sealed to a flange member fixed to the body part so that fuel from the fuel chamber is prevented from entering the portion of the body housing the tappet. Such a one-piece construction represents a simple and cost effective solution to the problems identified above.

[0006] The flange member is desirably provided with a duct for supplying lubrication oil to a lubricator groove adjacent the tappet arm. By further providing the flange member with a sealing ring, located between the lubricator groove and the fuel chamber, mixing of fuel and lubrication oil may be prevented. The body part may further include a chamber located between the flange member and the piston member for collecting any fuel leaked from the fuel chamber, as well as a drain duct for

draining such fuel. In such an arrangement, the chamber remains de-pressurized, which is of advantage in assisting the efficient operation of the seal.

[0007] In preferred embodiments the fuel chamber is fed with fuel from a low pressure fuel line of a fuel feed system, via a non-return valve. Preferably, the low pressure fuel line is provided with a control valve upstream of the non-return valve. Preferably, also, the fuel from the pump chamber is fed to the engine cylinder via a pressure accumulator. A common accumulator unit may be used for two or more cylinders. By these means the pump and tappet unit of the invention may readily be utilised in systems in which fuel is supplied from a tank under low pressure and pumped to the cylinder under high pressure.

[0008] Preferably, the body part is provided with a pipe element housing the low pressure fuel line, and with ducts connecting the pipe element with the fuel chamber. In addition, the pipe elements of the body parts of successive pump and tappet units may be connected to each other to provide a uniform low pressure fuel line. By connecting the downstream end of the fuel line via a constant pressure valve or the like back into the fuel tank, the uniform low pressure fuel feed line can advantageously be arranged to form a closed loop.

[0009] The invention will hereinafter be described in more detail by way of example only, with reference to the accompanying drawings, in which

Figure 1 is an axial section of an embodiment of pump and tappet unit according to the invention, with the tappet in its lower position;

Figure 2 is an axial section of the Figure 1 embodiment, with the tappet in its upper position;

Figure 3 is an axial section of a modified embodiment of pump and tappet unit according to the invention taken along a line corresponding to Line III-III of Figure 1; and

Figure 4 is a schematic representation of a plurality of units according to the invention arranged as part of a low pressure fuel line of a fuel feed system of an engine.

[0010] In the figures, reference numeral 1 indicates a body part of a pump and tappet unit which is mounted on an engine, for instance on its so called "console support" (not illustrated) by means of screw bolts 22. Body part 1 encloses a tappet member 2 movable against the force of a compression spring 6 and to which a roll follower 4 is journalled by means of a stub shaft 3. Tappet member 2 is governed in its axial movement in known manner by roll follower 4, which cooperates with a cam race 5 of a cam shaft of the engine (not shown).

[0011] Attached to the tappet member 2 is a tappet arm 7, at one end of which a piston member 8 is con-

nected to be movable against the force of a compression spring 9. A cover element 10, including a fuel chamber 11, is fixed to the body part 1 by means of screw bolts 27. The fuel chamber 11 is arranged in cooperation with the piston member 8 so that the piston member 8 pumps fuel in the direction shown in Figures 1 and 2, from the chamber 11 through a non-return valve 15 and a duct 16 either directly or through a pressure accumulator into one or more cylinders of the engine (not shown). (It is possible either to use pressure accumulators of known type, or, for example, to use accumulators of the type described and claimed in the applicants' earlier European Patent No. 99303884.3.) On the other hand fuel is led into the chamber 11 through a duct 12 (Figs 1 and 2), which is connected to a low pressure fuel line (Figs 3 and 4), via a control valve 13 and a non-return valve 14. By means of the control valve 13 the amount of fuel to be fed into the chamber 11 can be controlled and, if necessary, the feeding may temporarily be entirely cut off. A cylindrical lower part 10a of the cover element is shaped so as to retain spring 9 in position.

**[0012]** A separate flange member 17, through which the tappet arm 7 passes, is fixed to the body part 1 by means of screws 35. The flange member 17 is provided with one or more lubrication ducts 18, which connect a ring-like lubricator groove 21 to a lubricator groove 19 encircling the tappet arm 7. In addition the flange member 17 is provided with a sealing ring 20. Any fuel and/or lubricant accumulating in a chamber 28 located above the flange member 17 is drained away through a drain duct 29 (Fig 3). It is thus possible to minimise the problem of fuel becoming mixed with the lubricant.

**[0013]** With reference specifically to Figures 3 and 4 the body part 1 is provided with a pipe element 1a, having a duct 23 forming part of a fuel line 32 of a fuel feed system for the engine. In addition, the fuel feed system comprises a low pressure pump 31, which pumps fuel from a fuel tank 30 to the pump and tappet units (for the sake of simplicity Figure 4 shows only the body parts 1), and pipes 33 connecting these units to one another through the pipe elements 1a. The system also incorporates a constant pressure valve or a throttle valve 34, through which the fuel line 32 is led back into the fuel tank 30.

**[0014]** As is apparent from Figure 3, in each pump and tappet unit fuel is led from the duct 23 in the pipe element 1a through ducts 24, 25 and 26 into the duct 12 (schematically shown in Figures 1 and 2) and into the fuel chamber 11 of the pump. Integration of the pipe element 1a and the separate fuel ducts and lubricator ducts into the body part 1, which is manufactured as an integral item, makes the construction simpler and cheaper and results in a compact unit.

**[0015]** In the embodiment of Figure 3 the tappet arm 7 connecting the tappet member 2 to the piston member 8 is somewhat differently constructed from that shown in Figs 1 and 2. The tappet arm 7 may include two separate pieces, but these form one functional entity due to

the action of spring 9.

**[0016]** The invention is not restricted to the embodiments shown but several modifications are feasible within the scope of the attached claims.

## Claims

1. An integrated pump and tappet unit for supplying fuel to an internal combustion engine, such as a large diesel engine, the unit comprising a body part (1) enclosing a tappet member (2), whose axial movement is governed by movement of a cam surface provided on a cam shaft or the like; and a piston member (8) operationally connected to the tappet member (2) and which is arranged to pump fuel under high pressure from a fuel chamber (11) disposed within the body part (1), the fuel being fed either directly or through a pressure accumulator means into one or more cylinders of the engine, characterized in that the body part (1) is a single member housing both said tappet member (2) and said fuel chamber (11); and in that the tappet member (2) and the piston member (8) are connected to each other by means of a tappet arm (7), which is sealed to a flange member (17) fixed to the body part (1), so that fuel from the fuel chamber (11) is prevented from coming into contact with the tappet member (2).
2. A pump and tappet unit according to claim 1, characterized in that the flange member (17) is provided with a duct (18) adapted to provide lubrication oil to a lubricator groove (19) in the internal surface of the flange member abutting the tappet arm (7).
3. A pump and tappet unit according to claim 1 or 2, characterized in that the flange member (17) is provided with a sealing ring (20), which is located between the lubricator groove (19) and the fuel chamber (11), adapted to prevent fuel and lubrication oil becoming mixed.
4. A pump and tappet unit according to any one of the preceding claims, characterized in that the body part (1) includes a chamber (28) located between the flange member (17) and the piston member (8) for collecting any fuel leaked from the fuel chamber (11), said chamber (28) being provided with a drain duct (29).
5. A pump and tappet unit according to any one of the preceding claims, characterized in that the fuel chamber (11) supplied with fuel from a low pressure line (32) of a fuel feed system, via a non-return valve (14).
6. A pump and tappet unit according to claim 5, char-

acterized in that the low pressure fuel line (32) is provided with a control valve (13) upstream of the non-return valve (14).

7. A pump and tappet unit according to claim 5 or claim 6, characterized in that the body part (1) is provided with a pipe element (1a), housing the low pressure fuel line (32); and ducts (23,24,25,26,12) connecting the pipe element (1a) with the fuel chamber (11). 5
8. A plurality of pump and tappet units according to claim 7, characterized in that the pipe element (1a) of the body part (1) of successive pump and tappet units are connected to each other to provide a uniform low pressure fuel line (32). 10

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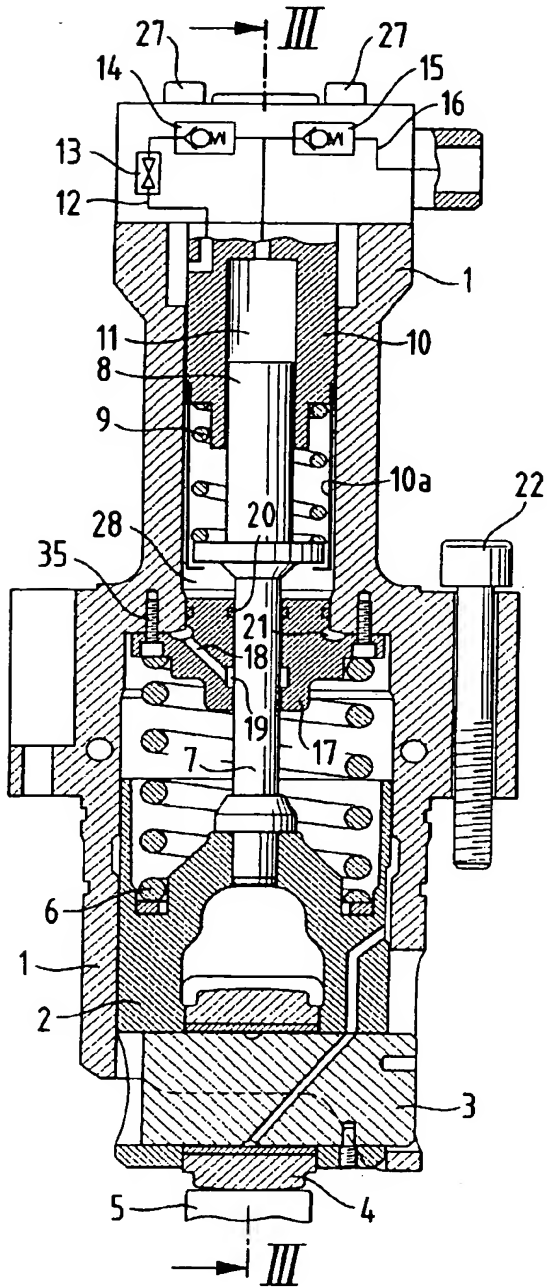
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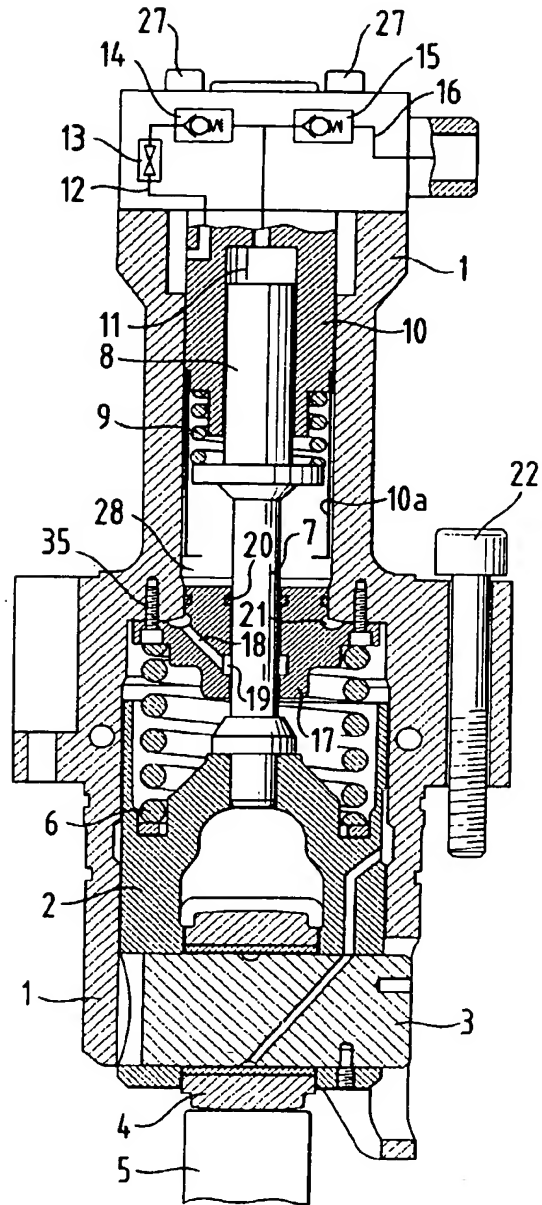
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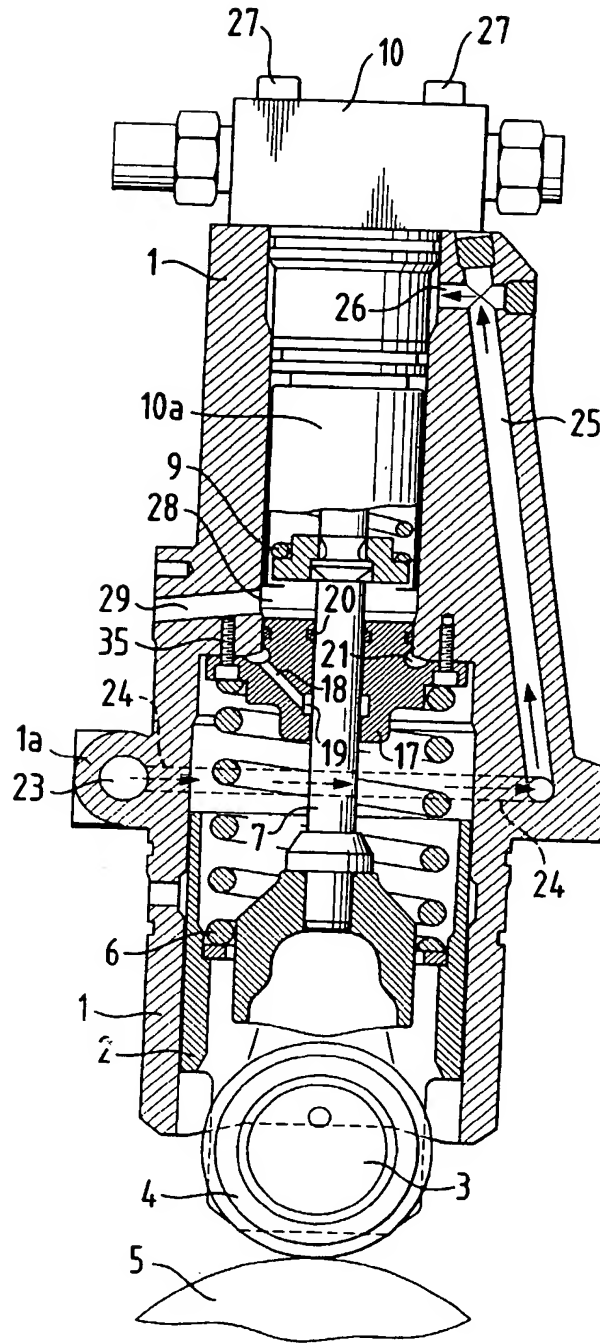
**Fig. 1**



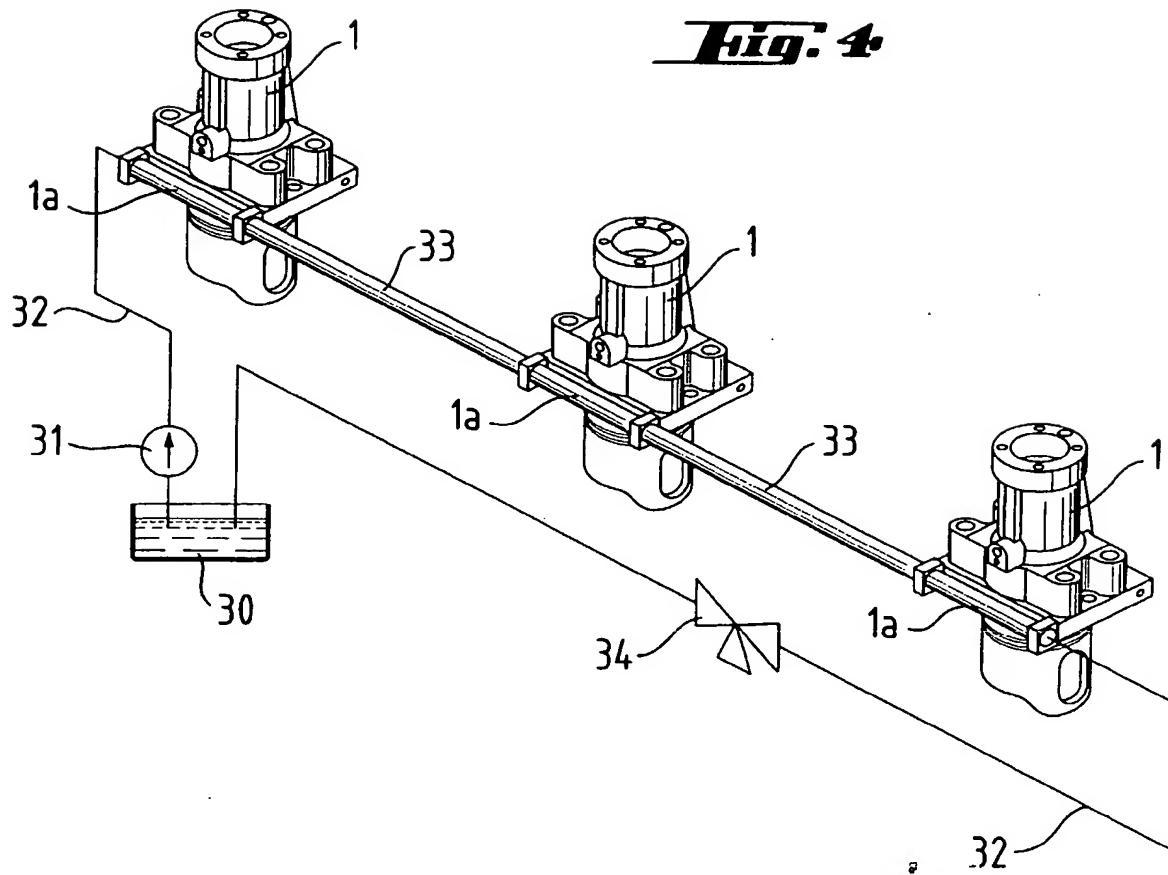
**Fig. 2**



**Fig. 3**

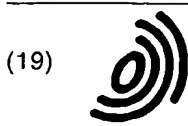


**Fig. 4**









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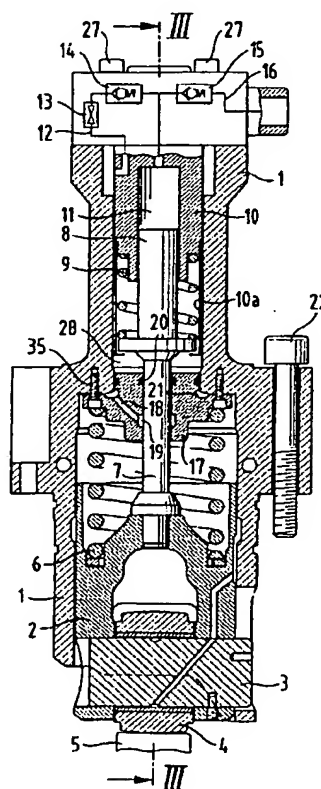
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**Fig. 1**



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## EUROPEAN SEARCH REPORT

Application Number

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 7)
X	US 5701872 A (KAKU et al.) 30 December 1997, fig. 2,6, column 5, line 65 - column 7, line 30, column 8, lines 10-41.	1-3, 5, 7	F02M59/44
A	-----	4, 6, 8	
			TECHNICAL FIELDS SEARCHED (Int. Cl. 7)
			F02M
The present search report has been drawn up for all claims			
Place of search VIENNA		Date of completion of the search 14-12-2000	Examiner PIPPAN
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application I : document cited for other reasons & : member of the same patent family, corresponding document			

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ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO. EP 99305199.4

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US A 5711870	30-12-1997	JP A2 0100462	20-05-1996

For more details about this annex see Official Journal of the European Patent Office, No. 12/82

